

Two-Drawn Drawing River for Treating Slope Field Soils

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ABSTRACT

The paper presents devices and principle of operation of a two-tier mouldboard ripper, as well as the results of research on justification of its design scheme and parameters. It is established that the most rational constructive scheme of the mouldboard two-tier ripper with inclined legs is the plough scheme with the alternation of the working elements of the upper without the mouldboard and the lower tier with the mouldboard; high-quality ripping is provided at a longitudinal distance of 60-70 cm between the working elements.

KEYWORDS: *water erosion, soil, technology, moldboard, two-tier ripper, slope*

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1. INTRODUCTION

It is known that the existing technologies of no-till tillage by rippers involve loosening the soil to a certain depth of tillage [1-4]. In this case, all the working bodies of the ripper carry out tillage to the same depth of tillage. At tillage by the existing rippers small triangular ridges formed at the bottom of the furrow do not allow to retain and accumulate rainwater after heavy and heavy rain, which leads to water erosion [5-11].

The authors have developed technology and plough-rake [6], which allows to get stepped furrow bottoms with big ridges on the furrow bottoms and ridges on the field surface. Combination of intra-soil ridges with surface ridges contributes to complete retention and accumulation of soil water (especially after heavy rainfall), respectively, water erosion is completely prevented.

The aim of the work is to develop a two-level mouldboard ripper for tillage of sloping fields.

2. Methods

The object of research is a two-tier mouldboard ripper for tillage of soils of sloping fields. The study applied the laws and rules of theoretical mechanics, agricultural mechanics, mathematical statistics and methods of strain measurement, as well as the methods given in the existing regulatory documents (TSt 63.04.2001, TSt 63.03.2001).

The two-tier ripper contains a frame 1, on which working tools 2 and 3 are mounted sequentially. Each working device consists of a stand 4 inclined in cross-vertical plane and a blade 5, a chisel 6, a field board 7 and a ripper plate 8 fixed thereon. Inclined part of the leg of the working body 2 is made with a lower height, and the inclined part of the

working body 3 with a higher height. The mouldboard 9 is attached to each working tool 3 with a higher height.

Two-tier moldboard ripper works in the following way. On the slopes of the fields with a slope α the tillage is carried out across the slope with plough- ripper. In the course of tillage chisel 6 of working body 2 with smaller height of sloping part gets into arable layer and breaks the soil chips. The resulting cracks spread to the soil surface at a certain angle γ . Moving forward at the speed of the aggregate movement, the chisel lifts the soil separate from the massif. At this moment, the blade 5 of the stand 4 penetrates into the zone of the soil deformed by the chisel. The soil, chipped with chisel, rising along it, goes to the blade 5, then to ripper 8, at the same time the soil chips are bending and stretching in longitudinal and cross sections, which leads to its intensive destruction. This process is completed when the chips come off the working surfaces of the ripping plate 8 under the action of inertial forces and gravity forces. Chisels 6 working body 3 with greater height going after the working body with lower height of inclined part of the column 2 penetrating into the subsoil layer - below the plow foot shears the soil shavings and under the action of the knife and ripper plates also loosens the soil intensively. Blade 9 of working unit 3 removes the top soil layer in front of its support, loosens and wraps the soil additionally. This creates ridges on the surface of the cultivated field. This helps to retain rainwater over the depression, resulting in water being absorbed into it.

Thus, after the plough-grubber passage, a stepped furrow bottom with periodic deepening (in-soil ridges), crossing the compacted subsoil and surface ridges are obtained.

Combination of in-soil ridges with surface ridges contributes to complete retention and accumulation of soil water

(especially after heavy rainfall), respectively, water erosion is completely prevented.

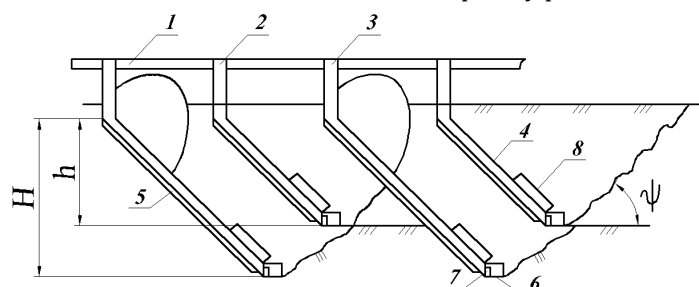


Fig.1. Technological process of the two-level mould board ripper

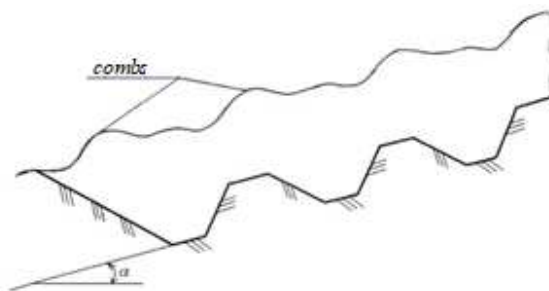


Fig.2. Cross-section of the field after the ripper pass

3. Results and discussion.

The program of experimental studies includes the study of the influence of the longitudinal distance between the lower and upper working bodies on the energy and agro-technical parameters of the ripper. At the same time on the lower working body was installed cultural blade.

Experiments were carried out at a set depth of the upper working body of 25 cm and the lower - 37 cm, the speed of 1.67 m/s.

Studies have shown (Fig. 3.19 and Table 3.5) that on cereal stubble with installation of working tools on frontal scheme, i.e. when $L=0$, the quality of ripper work is unsatisfactory. There were observed cases of clogging of working bodies by soil and plant residues. As layer wrapped by the blade of the lower working body is caught on the leg of the upper working body. At that, traction resistance of working tools reaches the maximum value (Fig. 3.19), because both working tools work in the conditions of blocked cutting. With increase of longitudinal distance from 0 to 0.6 m total traction resistance of upper and lower working tools intensively decreases, and further increase leads to insignificant decrease.

Increasing the longitudinal distance between the working bodies from 0 to 0.8 m leads to an improvement in the quality indicators of the ripper. Quality indicators of ripper are satisfied by all agrotechnical indicators at longitudinal distances of 0,5-0,8 m. However, increase of L leads to increase in length and weight of ripper. Therefore, the longitudinal distance between the working bodies should be chosen within 0,60-0,7 m.

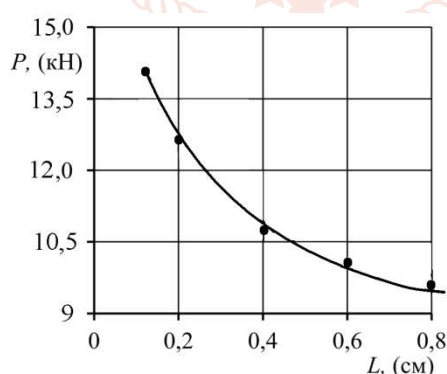


Fig.3. The graph of the traction resistance of the working elements P on the longitudinal distance L between them

Table 1 Influence of longitudinal distance between working tools on the agrotechnical performance of the ripper

Longitudinal distance between the working bodies, m	Ridgeiness (water-holding ridge), cm	Root-mean-square deviation of the working depth processing, cm	Stubble retention rate, %	Quality of layer crumbling by weight of the size of fractions less than 50 mm, %
0	13,8	4,4	83,5	72,5
0,2	13,6	3,4	83,4	70,9
0,4	13,3	3,2	83,6	68,8
0,5	12,9	3,1	83,9	66,4
0,6	12,8	2,7	83,5	64,8
0,7	12,8	2,6	84	63,9
0,8	12,9	2,5	84	63,8

Figure 4 shows that when the ripper works, a water-retaining ridge is formed on the surface of the field, which prevents water erosion.

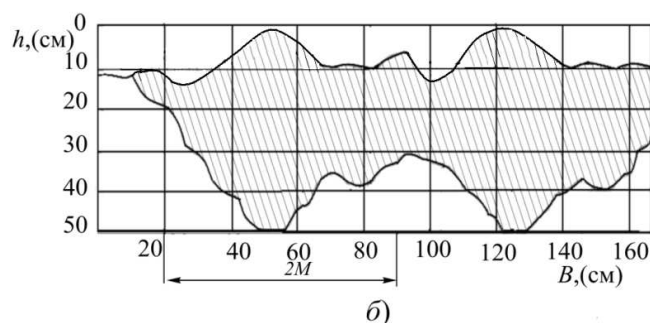


Fig.4. Cross-section profiles of the field surface and furrow bottom after the passage of the unit with one upper and one lower mouldboard

4. Conclusions

1. The protection of soils from water erosion, improvement of quality indicators of tillage of soils subject to water erosion, reduction of energy and material intensity of this agricultural technique can be achieved through the development and implementation of a two-tier moldboard ripper.
2. On the basis of studies of mutual arrangement and operating modes of the mouldboard ripper it is established that the most rational design scheme of the mouldboard two-tier ripper with inclined legs is a plough scheme with alternation of working elements of the upper without mouldboard and the lower tier with mouldboard; high-quality ripping is provided at longitudinal distance between working elements of 60-70 cm.

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